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SASKATCHEWAN CONSTRUCTION, UPGRADING & MAINTE
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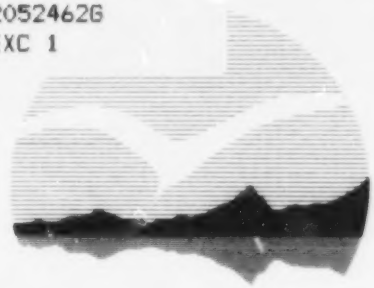

WATER
RESOURCES
BRANCH

SASKATCHEWAN DISTRICT

CONSTRUCTION, UPGRADING AND MAINTENANCE

1989 - 90 ANNUAL REPORT

SASKATCHEWAN

CONSTRUCTION, UPGRADING & MAINTENANCE

1989-90 ANNUAL REPORT

J.H. Chubak
June, 1990

Water Resources Branch
Regina, Saskatchewan

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1.0 INTRODUCTION

The Saskatchewan District, Water Resources Branch has a continuing construction program to maintain its network of about 330 hydrometric gauging stations. The program is carried out by in-house personnel except for specialized tasks, such as, earthwork, and supplying rocks, gravel and concrete, which are contracted out. Extensive use is made of prefabrication techniques and bulk purchases of construction supplies to reduce program costs and minimize field labour time.

Standard designs have been developed for such items as equipment shelters, stilling wells, metering bridges, cablecars and bench marks but items such as cableways and artificial controls are individually designed to meet specific site requirements. A description of construction practices, materials and equipment is contained in Appendix B.

Construction priorities are generally based on the following criteria;

1. Health and safety
2. Physical integrity of the gauging station
3. Continuity of data collection
4. New construction
5. Data quality
6. General repairs or dismantling of stations

Projects are constructed and operated under co-operative arrangements with the Province of Saskatchewan and other agencies. The hydrometric cost-sharing agreement with the Province of Saskatchewan is described in the next section and cost responsibilities detailed.

This report also contains cost summaries, definitions, a history of expenditures from 1982-83 to 1989-90. A brief description and cost breakdown for projects completed in 1989-90, a description of construction practices, materials and equipment, photographs, and a location map are included in appendices.

For the purposes of this report, the projects are divided into three categories:

1. CONSTRUCTION (C)

   Installation of structures, equipment and instrumentation at a new gauging station.

2. UPGRADING (U)

   Installation of facilities at existing gauging stations to collect additional data, improve the quality of data or facilitate the collection of data.

3. MAINTENANCE (M)

   Repair and refurbishing of facilities at existing gauging stations or the removal of discontinued gauging stations and site restoration.

2.0 COST-SHARING ARRANGEMENTS

The cost-sharing arrangements between Canada and the Province of Saskatchewan are defined in the Memorandum of Agreement for Water Quantity Surveys signed by both governments on February 18, 1975. Under the terms of the Agreement, each gauging station is classified Federal, Federal-Provincial or Provincial by a Co-ordinating Committee. This classification is formalized annually through Schedule A to the Agreement and is the basis for sharing construction costs between the two governments.

Shareable construction costs are defined in the Memorandum of Agreement and Schedule B to the Agreement. In summary, direct costs such as salaries of construction personnel, field travel expenses, vehicle costs, construction materials, contract payments for services and depreciation of construction equipment are shareable. Stations classified as Federal are the cost responsibility of Canada, stations classified as Federal-Provincial are cost shared equally and stations classified as Provincial are the cost responsibility of the Province of Saskatchewan. The exceptions relate to equipment and instrumentation, whereby under Article VII of the Memorandum of Agreement, the operating agency is responsible for providing and paying the total cost of the basic water level recording equipment. Specialized equipment and/or instrumentation is paid for by the party or parties requiring the service.

Determination of the construction program is a joint consultative process with the Province of Saskatchewan and results in a program which is a blend of both federal and provincial government priorities. Priority changes during the year are also reviewed with the province and other government departments.

3.0 CONSTRUCTION PROGRAM 1989-90

The 1989-90 construction program consisted of 66 projects (8 upgrading and 58 maintenance). The original construction program was modified, 12 projects deleted and 14 projects added, during the year to maintain safety and operational standards.

The work was carried out by the construction supervisor and a crew which consisted of a construction foreman, a construction assistant and a summer student with additional help from hydrometric personnel as required. Extensive use was made of prefabrication techniques and the foreman was employed during the winter period for this function.

The eight upgrading projects completed this year ranged from construction of artificial controls to removing and reinstalling gauging stations. Two of the projects, South Saskatchewan River at Saskatoon (05HG001), Photos 1 and 2, and North Saskatchewan River at Prince Albert (05GG001), Photo 3, were built within the guidelines of Meewasin Authorities and the City of Prince Albert requirements respectively.

Ten of the fifty-eight maintenance projects required extensive work which consisted of, replacing wooden structure cableways with standard metal ones, rebuilding controls, repairing vandalized stations, removing and salvaging discontinued stations. General maintenance was carried out at the remaining stations to maintain safety, operational and environmental standards. A prototype cablecar brake was designed and installed at Qu'Appelle River below Craven Dam (05JK002).

Vandals struck at two northern remote sites, Fond-du-Lac River below Outlet of Black Lake (07LE002) and Dillon River at Outlet of Dillon Lake (06BA002), Photos 4 and 5. Cost of repairs to the stations was $4 000.

All projects identified for the 1989-90 Saskatchewan hydrometric construction program were subjected to a preliminary assessment to determine potential adverse environmental effects. Fourteen projects were subsequently screened as required by the federal Environmental Assessment and Review Process but none was judged to result in significant alteration to the natural environment.

The total cost of the 1989-90 construction program was $98 747.21. The provincial share of the cost was $24 239.45 and the federal share was $74 507.76. A summary of the projects and their costs is given in Table 1 and a detailed costing of each project is contained in Appendix A. The breakdown of the federal and provincial shares into construction, upgrading and maintenance costs is illustrated in Figure 1.

A comparison of the 1989-90 construction program and programs for the previous 8 years is given in Table 2 and shown graphically in Figure 2.

Figure 3 shows the average expenditure for upgrading and maintaining the federal and provincial networks. The federal network was assumed to be those stations classified as federal and half of the stations classified as federal-provincial. Similarly, the provincial network was assumed to consist of stations classified as provincial and half of the stations classified as federal-provincial. Overall, the long term average annual expenditure for maintaining and upgrading the network is about $400 per station.

Table 3 presents some approximate costs for gauging station installation and instrumentation.

TABLE 1

SUMMARY OF CONSTRUCTION COSTS - SASKATCHEWAN

1989-1990

	STATION	STATION NO.	TOTAL COST ($)	SHARE ($) FED	PROV
FEDERAL - PROVINCIAL STATIONS					
U-1	SOUTH SASKATCHEWAN RIVER AT SASKATOON	05HG001	16,747.66	8,373.83	8,373.83
			16,747.66	8,373.83	8,373.83
M-1	ALCOTT CREEK ABOVE MEADOW LAKE	06AD011	1,024.13	512.07	512.06
M-2	BEAVER RIVER BELOW WATERHEN RIVER	06AG001	4,121.66	2,060.83	2,060.83
M-3	CARROT RIVER NEAR ARMELY	05KB003	743.98	371.99	371.99
M-4	FIR RIVER NEAR HUDSON BAY	05LB007	604.71	302.36	302.35
M-5	GAINSBOROUGH CREEK NEAR STORTHOAKS	05NF013	915.45	457.73	457.72
M-6	GIBSON CREK NEAR RADVILLE	05NA005	1,334.56	667.28	667.28
M-7	JEWEL CREEK NEAR GOODWATER	05NB014	738.00	369.00	369.00
M-8	JUMPING DEER CREEK NEAR LIPTON	05JK004	175.00	87.50	87.50
M-9	MONNERY RIVER NEAR PARADISE HILL	05EF004	1,225.37	612.69	612.68
M-10	MOOSE JAW RIVER NEAR ROULEAU	05JE004	396.78	198.39	198.39
M-11	MOOSE MOUNTAIN CREEK BELOW MOOSE MOUNTAIN LAKE	05NC001	180.00	90.00	90.00
M-12	MOOSOMIN LAKE NEAR MOOSOMIN	05NE002	234.29	117.15	117.14
M-13	OSCAR CREEK NEAR KRYDOR	06GD002	1,306.06	653.03	653.03
M-14	PINTO CREEK NEAR WOODROW	05JA004	871.22	435.61	435.61
M-15	PIPESTONE CREEK NEAR MOOSOMIN	05NE001	741.56	370.78	370.78
M-16	ROMANCE CREEK NEAR WATSON	05MA016	381.29	190.65	190.64
M-17	SMITH CREEK NEAR MARCHWELL	05ME007	499.96	249.98	249.98
M-18	SNAKEBITE CREEK NEAR BEECHY	05HE001	2,396.66	1,198.33	1,198.33
M-19	SPIRIT CREEK NEAR BUCHANAN	05MB007	303.02	151.51	151.51
M-20	STURGEON-WEIR RIVER AT LEAF RAPIDS	05KG007	1,478.65	739.33	739.32
M-21	WASCANA CREEK BELOW KRONAU MARSH	05JF012	729.66	364.83	364.83
M-22	WASCANA CREEK NEAR SEDLEY	05JF004	180.00	90.00	90.00
M-23	WHITE FOX RIVER NEAR GARRICK	05KE005	2,205.29	1,102.65	1,102.64
M-24	WHITESAND RIVER NEAR CANORA	05MB003	685.28	342.64	342.64
M-25	WILLOW BROOK AT WILLOWBROOK	05MB005	758.89	379.45	379.44
M-26	YORKTON CREEK NEAR EBENEZER	05MB001	197.40	98.70	98.70
			24,428.87	12,214.48	12,214.39
FEDERAL STATIONS					
U-2	BATTLE CREEK NEAR CONSUL	11AB096	3,555.16	3,555.16	
U-3	BEAVER CREEK AT INTERNATIONAL BOUNDARY	11AF005	2,963.02	2,963.02	
U-4	HUFF LAKE GRAVITY CANAL	11AC065	7,116.80	7,116.80	
U-5	MIDDLE CREEK BELOW MIDDLE CREEK RES.	11AB001	1,251.53	1,251.53	
U-6	NORTH SASKATCHEWAN RIVER AT PRINCE ALBERT	05GG001	14,728.93	14,728.93	
U-7	QU'APPELLE RIVER ABOVE BUFFALO POUND LAKE	05JG004	5,384.76	5,384.76	
U-8	SOURIS RIVER NEAR GLEN EWEN	05ND001	960.87	960.87	
			35,961.07	35,961.07	
M-27	ARCOLA INDEX RESERVOIR	05NC005	342.43	342.43	
M-28	BATTLE CREEK AT ALBERTA BOUNDARY	11AB117	1,722.55	1,722.55	
M-29	BATTLE CREEK BELOW NASHLYN PROJECT	11AB101	842.79	842.79	
M-30	CYPRESS LAKE	11AC037	425.40	425.40	
M-31	CYPRESS LAKE EAST OUTFLOW CANAL	11AC060	448.75	448.75	
M-32	DENNIEL CREEK NEAR VAL MARIE	11AC025	412.46	412.46	
M-33	DILLON RIVER BELOW DILLON LAKE	06BA002	2,023.15	2,023.15	

TABLE 1

SUMMARY OF CONSTRUCTION COSTS - SASKATCHEWAN

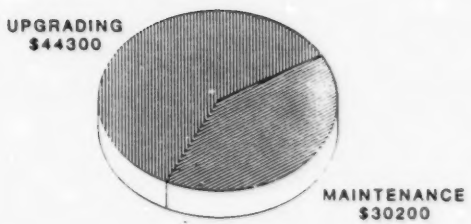
1989-1990

	STATION	STATION NO.	TOTAL COST ($)	SHARE ($) FED	PROV
FEDERAL (continued)					
M-34	EAST POPLAR RIVER AT INTERNATIONAL BOUNDARY	11AE003	568.39	568.39	
M-35	FAHLMAN CREEK NEAR DAVIN	05JF008	326.63	326.63	
M-36	FOND DU LAC RIVER AT OUTLET OF BLACK LAKE	07LE002	1,728.54	1,728.54	
M-37	LAST MOUNTAIN LAKE AT ROWAN'S RAVINE	05JH004	598.02	598.02	
M-38	LONG CREEK NEAR ESTEVAN	05NB001	1,168.06	1,168.06	
M-39	PIPESTONE CREEK ABOVE MOOSOMIN RESERVOIR	05NE003	576.74	576.74	
M-40	PIPESTONE CREEK NEAR THE SASKATCHEWAN BOUNDARY	05NG024	898.39	898.39	
M-41	QU'APPELLE RIVER BELOW LOON CREEK	05JK007	2,511.27	2,511.27	
M-42	STONY RAPIDS CREW CABIN	07LE000	332.65	332.65	
M-43	SWIFT CURRENT CANAL AT SWIFT CURRENT	05HD034	410.60	410.60	
M-44	SWIFT CURRENT CREEK BELOW ROCK CREEK	05HD036	1,578.50	1,578.50	
M-45	TATAGWA LAKE DRAIN NEAR WEYBURN	05NB018	1,043.06	1,043.06	
			17,958.38	17,958.38	
PROVINCIAL STATIONS					
M-46	CONJURING CREEK NEAR PREECEVILLE	05MC004	671.24		671.24
M-47	CUTKNIFE CREEK NEAR CUTKNIFE	05FF003	308.36		308.36
M-48	HUNTER CREEK NEAR RICHARDSON	05JF014	157.00		157.00
M-49	INVERNESS CREEK NEAR BRODERICK	05HG021	785.09		785.09
M-50	IRONSPRING CREEK NEAR WATSON	05MA012	258.66		258.66
M-51	JACKFISH LAKE NEAR COCHIN	05EG003	907.88		907.88
M-52	JACKFISH LAKE NEAR PRINCE	05EG007	55.35		55.35
M-53	LITTLE BRIDGE CREEK NEAR ARMLEY	05KB008	382.96		382.96
M-54	MORIN CREEK NEAR MEADOW LAKE	06AD008	195.00		195.00
M-55	MUDDY LAKE INFLOW NEAR REVENUE	05GB004	258.66		258.66
M-56	OVERFLOWING RIVER NEAR HUDSON BAY	05LD003	497.58		497.58
M-57	PAGE CREEK NEAR IFFLEY	05EG008	-92.65		-92.65
M-58	VAN PATTENS CREEK NEAR KUROKI	05MB011	-733.90		-733.90
			3,651.23		3,651.23
GRAND TOTALS			98,747.21	74,507.76	24,239.45

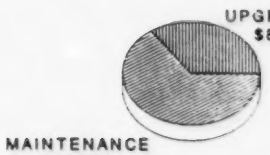
SUMMARY

	Total	Federal	Provincial
Construction	0	0	0
Upgrading	$52,708.73	$44,334.90	$ 8,373.83
Maintenance	$46,038.48	$30,172.86	$15,865.62

CONSTRUCTION PROGRAM
1989-90



FEDERAL SHARE
$74 500



PROVINCIAL SHARE
$24 200

FIGURE 1

ANNUAL EXPENDITURES

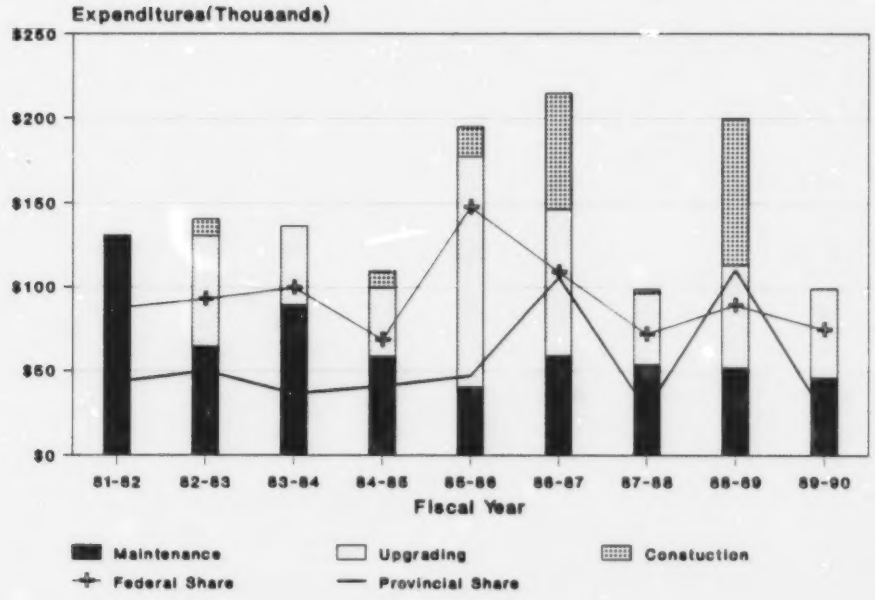


FIGURE 2

UPGRADING AND MAINTENANCE AVERAGE EXPENDITURE PER STATION

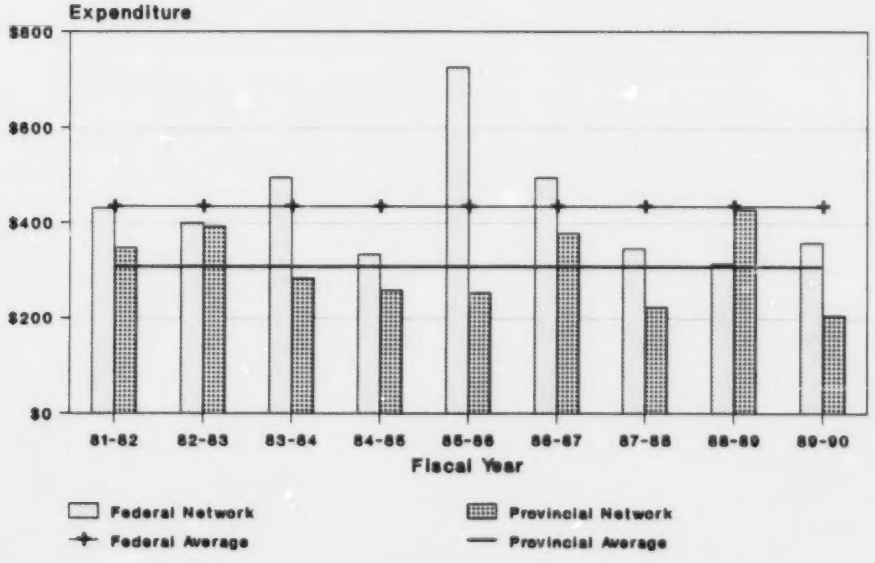


FIGURE 3

TABLE 2

YEARLY COST COMPARISON 1982-1990

YEAR	Number of Projects	Expenditures
1982-83	C - 1	9 700.28
	U - 11	65 890.10
	M - 43	64 696.85
	55	140 287.23
1983-84	C - 0	0
	U - 8	46 927.97
	M - 70	89 264.62
	78	136 192.59
1984-85	C - 1	9 735.57
	U - 8	40 963.19
	M - 59	58 708.10
	68	109 406.86
1985-86	C - 1	17 209.11
	U - 13	137 020.96
	M - 50	40 543.90
	64	194 773.97
1986-87	C - 3	68 632.80
	U - 19	87 126.73
	M - 50	59 088.13
	72	214 847.66
1987-88	C - 1	2 467.14
	U - 8	42 244.37
	M - 93	53 979.16
	102	98 690.67
1988-89	C - 5	86 427.72
	U - 9	61 084.11
	M - 61	52 506.73
	75	200 018.56
1989-90	C - 0	0
	U - 8	52 708.73
	M - 57	46 038.48
	65	98 747.21

TABLE 3

APPROXIMATE CURRENT COSTS FOR ESTIMATING PURPOSES

FABRICATED ITEMS	COST ($)
Included are the material and labour to fabricate the following:	
Standard 1500 mm diameter wood stave well (per metre of length)	275.00
Standard unwired shelter with well base	2 050.00
Standard unwired shelter with concrete base	2 200.00
Electrical wiring (per shelter)	780.00
Super insulated shelter	2 450.00
Cableway (2.5 m A-frames, cablecar, deadman)	3 330.00
Cableway 19 mm cable (per metre of length)	7.00
Sheet steel pile control (per lineal metre)	400.00
INSTRUMENTATION	
Servo-manometer, CAE Stacom	5 035.00
Recorder, A71 Stevens	3 590.00
Data Collection Platform (Bristol), antenna, terminal strip	5 340.00
Photovoltaic system	417.00
Memomark III & A-71 Mounts	1 730.00
Wire Weight Gauge	350.00
Electric Tape Gauge	180.00
Gauge plate (1 m section)	10.00
Batteries - Northern Region	200.00
- Southern Region	100.00

APPENDIX A

DETAILED CONSTRUCTION COSTS

CONSTRUCTION PROJECT INDEX

STATION NAME	STATION NUMBER	PAGE
ALCOTT CREEK ABOVE MEADOW LAKE	06AD011	16
ARCOLA INDEX RESERVOIR	05NC006	34
BATTLE CREEK AT ALBERTA BOUNDARY	11AB117	34
BATTLE CREEK BELOW NASHLYN PROJECT	11AB101	35
BATTLE CREEK NEAR CONSUL	11AB096	29
BEAVER CREEK AT INTERNATIONAL BOUNDARY	11AF005	30
BEAVER RIVER BELOW WATERHEN RIVER	06AG001	16
CARROT RIVER NEAR ARMLEY	05KB003	17
CONJURING CREEK NEAR PREECEVILLE	05MC004	44
CUTKNIFE CREEK NEAR CUTKNIFE	05FF003	44
CYPRESS LAKE EAST OUTFLOW CANAL	11AC060	36
CYPRESS LAKE	11AC037	35
DENNIEL CREEK NEAR VAL MARIE	11AC025	36
DILLON RIVER BELOW DILLON LAKE	06BA002	37
EAST POPLAR RIVER AT INTERNATIONAL BOUNDARY	11AE003	37
FAHLMAN CREEK NEAR DAVIN	05JF008	38
FIR RIVER NEAR HUDSON BAY	05LB007	17
FOND DU LAC RIVER AT OUTLET OF BLACK LAKE	07LE002	38
GAINSBOROUGH CREEK NEAR STORTHOAKS	05NF013	18
GIBSON CREEK NEAR RADVILLE	05NA005	18
HUFF LAKE GRAVITY CANAL	11AC065	31
HUNTER CREEK NEAR RICHARDSON	05JF014	45
INVERNESS CREEK NEAR BRODERICK	05HG021	45
IRONSPRING CREEK NEAR WATSON	05MA012	46
JACKFISH LAKE NEAR COCHIN	05EG003	46
JACKFISH RIVER NEAR PRINCE	05EG007	47
JEWEL CREEK NEAR GOODWATER	05NB014	19
JUMPING DEER CREEK NEAR LIPTON	05JK004	19
LAST MOUNTAIN LAKE AT ROWAN'S RAVINE	05JH004	39
LITTLE BRIDGE CREEK NEAR ARMLEY	05KB008	47
LONG CREEK NEAR ESTEVAN	05NB001	39
MIDDLE CREEK BELOW MIDDLE CREEK RESERVOIR	11AB001	32
MONNERY RIVER NEAR PARADISE HILL	05EF004	20
MOOSE JAW RIVER NEAR ROULEAU	05JE004	20
MOOSE MOUNTAIN CREEK BELOW MOOSE MOUNTAIN LAKE	05NC001	21
MOOSOMIN LAKE NEAR MOOSOMIN	05NE002	21
MORIN CREEK NEAR MEADOW LAKE	06AD008	48
MUDDY LAKE INFLOW NEAR REVENUE	05GB004	48
NORTH SASKATCHEWAN RIVER AT PRINCE ALBERT	05GG001	32
OSCAR CREEK NEAR KRYDOR	05GD002	22
OVERFLOWING RIVER NEAR HUDSON BAY	05LD003	49
PAGE CREEK NEAR IFFLEY	05EG008	49
PINTO CREEK NEAR WOODROW	05JA004	22
PIPESTONE CREEK ABOVE MOOSOMIN RESERVOIR	05NE003	40
PIPESTONE CREEK NEAR THE SASKATCHEWAN BOUNDARY	05NG024	40
PIPESTONE CREEK NEAR MOOSOMIN	05NE001	23
QU'APPELLE RIVER BELOW LOON CREEK	05JK007	41
QU'APPELLE RIVER ABOVE BUFFALO POUND LAKE	05JG004	33
ROMANCE CREEK NEAR WATSON	05MA016	23

CONSTRUCTION PROJECT INDEX

STATION NAME	STATION NUMBER	PAGE
SMITH CREEK NEAR MARCHWELL	05ME007	24
SNAKEBITE CREEK NEAR BEECHY	05HE001	24
SOURIS RIVER NEAR GLEN EWEN	05ND001	33
SOUTH SASKATCHEWAN RIVER AT SASKATOON	05HG001	15
SPIRIT CREEK NEAR BUCHANAN	05MB007	25
STONY RAPIDS CREW CABIN	07LE000	41
STURGEON-WEIR RIVER AT LEAF RAPIDS	05KG007	25
SWIFT CURRENT CANAL AT SWIFT CURRENT	05HD034	42
SWIFT CURRENT CREEK BELOW ROCK CREEK	05HD036	42
TATAGWA LAKE DRAIN NEAR WEYBURN	05NB018	43
VAN PATTENS CREEK NEAR KUROKI	05MB011	50
WASCANA CREEK NEAR SEDLEY	05JF004	26
WASCANA CREEK BELOW KRONAU MARSH	05JF012	26
WHITE FOX RIVER NEAR GARRICK	05KE005	27
WHITESAND RIVER NEAR CANORA	05MB003	27
WILLOW BROOK AT WILLOWBROOK	05MB005	28
YORKTON CREEK NEAR EBENEZER	05MB001	28

A.0 DETAILED CONSTRUCTION COSTS

A.1 DEFINITIONS FOR GAUGING STATIONS AND COST BREAKDOWN

The following definitions are used for individual stations.

LABOUR	The cost includes salaries for the construction foreman, construction assistant and actual on-site time for the construction supervisor. Salaries of hydrometric staff are not included.
BOARD & ACCOMMODATION	Meals and living accommodation for personnel
TRAVEL	Road and air travel costs for labour, equipment and materials, or freight costs of materials and equipment to pick up point
MATERIALS	Components and supplies used in construction and maintenance of gauging stations (instruments excluded)
CONTRACT SERVICE	All services supplied by outside sources such as aircraft, earth moving, machinery rental, electrical wiring, trucking of gravel, rock and concrete, etc.
INSTRUMENTS	Servo-manometer, Type A recorder, Telemark and Code-A-Phone adaptor, Electric Tape Gauge, staff gauge plates, special instrumentation and DCP.
UTILITIES	Construction of power, telephone lines and required connections to gauging station facilities
SALVAGE MATERIAL	Salvaged material is credited to the station.
ELECTRICAL WIRING	The installation of 115 V, 30 A service entrance complete with steel mast, meter socket, two dual receptacles, one ceiling light complete with switch, and one utility box with pilot light switch for heat tape connection
HEAT TAPES	Pyrotenax copper Design A-type heating cable units are being used. The cold lead when incorporated, is common underground cable such as Canada Wire-F-NMW-10 Endurex 14/2 with ground. Heat tape and ground wire splices are soldered and covered with heat-shrink tubing.

A.2 FEDERAL-PROVINCIAL STATIONS

A.2.1 Federal-Provincial Upgrading

U-1 South Saskatchewan River at Saskatoon - 05HG001 - Federal-Provincial

Replaced the manometer type installation with a float activated type. The unique building design and the defined bank restoration was requested by Meewasin Valley Authority.

Installed a 1.5 m x 5.8 m well on a 2.5 m x 2.5 m concrete slab. Installed a 0.2 m x 11.0 m plastic pipe upper intake, a 3 NPS x 13.5 m metal pipe lower intake complete with a flushing unit and a heat tape. The 1.8 m x 2.5 m cottage roof shelter was framed in the warehouse. The 1500W forced air heater, wiring, paneling, instrument shelves and the cedar shakes were installed on site. All the disturbed and backfilled area was hand raked. Replaced the electrical overhead power service with an underground installation. Installed two rod-type bench marks with standard markers. Removed the existing shelter along with its heavy concrete slab, removed the dilapidated water quality shelter. (No salvage material).

Construction Cost:

Labour	8 225.16
Board & Accommodation	2 428.35
Travel	1 146.50
Material	3 620.15
Contract Services	3 320.00
Total	18 740.16

Instrumentation Costs:

Electric Tape Gauge	180.00
Salvaged manometer system	-2 172.50
Total	-1 992.50

Station Cost

Federal Share	8 373.83
Provincial Share	8 373.83
Total	16 747.66

Project Completed November 14, 1989

A-2-2 Federal-Provincial Maintenance

M-1 Alcott Creek above Meadow Lake - 06AD011 - Federal-Provincial

Installed a screw-type bench mark with a standard marker. Replaced the heat tape with a new pyrotenax type. Installed a 2 NPS x 1.0 m standard pipe to protect the heat tape.

Construction Cost:

Labour	303.03
Board & Accommodation	182.37
Travel	302.50
Material	236.23
Total	1 024.13

Station Cost

Federal Share	512.07
Provincial Share	512.06
Total	1 024.13

Project Completed July 13, 1989

M-2 Beaver River below Waterhen River - 06AG001 - Federal-Provincial

Replaced the wooden A-frame with a extended (4.3 m) metal pipe one. Built and installed a 1 830 mm x 1 830 mm metal loading platform complete with hand railing and an aluminum ladder. Installed a screw-type bench mark with a standard marker.

Construction Cost:

Labour	1 309.06
Board & Accommodation	672.03
Travel	1 090.00
Material	1 050.57
Total	4 121.66

Station Cost

Federal Share	2 060.83
Provincial Share	2 060.83
Total	4 121.66

Project Completed July 14, 1989

M-3 Carrot River near Armley - 05KB003 - Federal-Provincial

Built and installed a 50 m x 25 mm metal pipe metering bridge frame safety tie rail.

Construction Cost:

Labour	303.03
Board & Accommodation	192.00
Travel	31.50
Material	217.45
Total	743.98

Station Cost

Federal Share	371.99
Provincial Share	371.99
Total	743.98

Project Completed August 10, 1989

M-4 Fir River near Hudson Bay - 05LB007 - Federal-Provincial

Replaced the heat tape with a pyrotenax type and repaired the flushing unit.

Construction Cost:

Labour	324.40
Board & Accommodation	88.56
Travel	75.00
Material	116.75
Total	604.71

Station Cost

Federal Share	302.36
Provincial Share	302.35
Total	604.71

Project Completed March 8, 1989

M-5 Gainsborough Creek near Storthoaks - 05NF013 - Federal-Provincial

Replaced the heat tape, installed ETG, and repaired the flushing unit.

Construction Cost:

Labour	303.03
Board & Accommodation	205.24
Travel	127.50
Material	122.48
Total	758.25

Instrumentation Costs

Electric Tape Gauge	157.20
Total	157.20

Station Cost

Federal Share	457.73
Provincial Share	457.72
Total	915.45

Project Completed June 1, 1989

M-6 Gibson Creek near Radville - 05NA005 - Federal-Provincial

Replaced the wooden loading platform with a 1370 mm x 1828 mm metal one. Replaced the heat tape with a pyrotenax type.

Construction Cost:

Labour	606.06
Board & Accommodation	233.50
Travel	195.00
Material	300.00
Total	1 334.56

Station Cost

Federal Share	667.28
Provincial Share	667.28
Total	1 334.56

Project Completed June 14, 1989

M-7 Jewel Creek near Goodwater - 05NB014 - Federal-Provincial

Replaced the heat tape with a pyrotenax type. Repaired the well crib.

Construction Cost:

Labour	303.03
Board & Accommodation	170.81
Travel	142.50
Material	121.66
Total	738.00

Station Cost

Federal Share	369.00
Provincial Share	369.00
Total	738.00

Project Completed July 25, 1989

M-8 Jumping Deer Creek near Lipton - 05JK004 - Federal-Provincial

Removed beaver dam from control. (Work done by hydrometric personnel.

Construction Cost:

Contract Services	175.00
Total	175.00

Station Cost

Federal Share	87.50
Provincial Share	87.50
Total	175.00

Project Completed March 21, 1989

M-9 Monnery River near Paradise Hill - 05EF004 - Federal-Provincial

Replaced the heat tape with a pyrotenax type and repaired the flushing unit.

Construction Cost:

Labour	556.00
Board & Accommodation	348.60
Travel	180.00
Material	140.77
Total	1 225.37

Station Cost

Federal Share	612.69
Provincial Share	612.68
Total	1 225.37

Project Completed February 7, 1989

M-10 Moose Jaw River near Rouleau - 05JE004 - Federal-Provincial

Replaced the heat tape with a pyrotenax type.

Construction Cost:

Labour	178.78
Board & Accommodation	17.00
Travel	15.00
Material	186.00
Total	396.78

Station Cost

Federal Share	198.39
Provincial Share	198.39
Total	396.78

Project Completed March 20, 1989

M-11 Moose Mountain Creek below Moose Mountain Lake - 05NC001 - Federal-Provincial

Installed an electric tape gauge. (Work done by hydrometric personnel).

Instrumentation Costs

Electric Tape Gauge	180.00
Total	180.00

Station Cost

Federal Share	90.00
Provincial Share	90.00
Total	180.00

Project Completed July 11, 1989

M-12 Moosomin Lake near Moosomin - 05NE002 - Federal-Provincial

Filled in erosion and leveled shelter.

Construction Costs

Labour	108.38
Board & Accommodation	63.41
Travel	62.50
Total	234.29

Station Cost

Federal Share	117.15
Provincial Share	117.14
Total	234.29

Project Completed June 29, 1989

M-13 Oscar Creek near Krydor - 05GD002 - Federal-Provincial

Inserted a 3 NPS plastic (ABS) pipe into the deteriorating wooden box intake. Added rocks to the riprap downstream of the control.

Construction Cost:

Labour	579.89
Board & Accommodation	250.97
Travel	189.00
Material	36.20
Contract Services	250.00
Total	1 306.06

Station Cost

Federal Share	653.03
Provincial Share	653.03
Total	1 306.06

Project Completed January 4, 1990

M-14 Pinto Creek near Woodrow - 05JA004 - Federal-Provincial

Repaired lightning damaged electrical wiring system. Replaced damaged heat tape with a pyrotenax type.

Construction Cost:

Labour	374.32
Board & Accommodation	163.86
Travel	200.00
Material	133.04
Total	871.22

Station Cost

Federal Share	435.61
Provincial Share	435.61
Total	871.22

Project Completed September 28, 1989

M-15 Pipestone Creek near Moosomin - 05NE001 - Federal-Provincial

Installed a screw-type and a rod-type bench mark both with standard marker.

Construction Cost:

Labour	303.03
Board & Accommodation	175.08
Travel	128.75
Material	134.70
Total	741.56

Station Cost

Federal Share	370.78
Provincial Share	370.78
Total	741.56

Project Completed June 28, 1989

M-16 Romance Creek near Watson - 05MA016 - Federal-Provincial

Replaced the heat tape and repaired flushing unit.

Construction Cost:

Labour	149.89
Board & Accommodation	69.77
Travel	39.00
Material	122.63
Total	381.29

Station Cost

Federal Share	190.65
Provincial Share	190.64
Total	381.29

Project Completed January 4, 1989

M-17 Smith Creek near Marchwell - 05ME007 - Federal-Provincial

Replaced the heat tape with a pyrotenax type.

Construction Cost:

Labour	194.08
Board & Accommodation	126.00
Travel	60.00
Material	119.88
Total	499.96

Station Cost

Federal Share	249.98
Provincial Share	249.98
Total	499.96

Project Completed March 7, 1989

M-18 Snakebite Creek near Beechy - 05HE001 - Federal-Provincial

Replaced the deteriorated wooden A-frame with a standard one on the left bank and a 2 m steel pipe one on the right bank. Reinstalled the existing metal loading platform and steps. Installed sag markers.

Construction Cost:

Labour	807.88
Board & Accommodation	332.04
Travel	491.75
Material	764.99
Total	2 396.66

Station Cost

Federal Share	1 198.33
Provincial Share	1 198.33
Total	2 396.66

Project Completed November 29, 1989

M-19 Spirit Creek near Buchanan - 05MB007 - Federal-Provincial

Installed a screw-type bench mark with a standard marker.

Construction Cost:

Labour	101.01
Board & Accommodation	62.01
Travel	65.00
Material	75.00
Total	303.02

Station Cost

Federal Share	151.51
Provincial Share	151.51
Total	303.02

Project Completed June 30, 1989

M-20 Sturgeon-Weir River at Leaf Rapids - 05KG007 - Federal-Provincial

Installed a loading platform and steps on the left A-frame. Extended the platform area on the right bank.

Construction Cost:

Labour	687.10
Board & Accommodation	342.10
Travel	203.75
Material	245.70
Total	1 478.65

Station Cost

Federal Share	739.33
Provincial Share	739.32
Total	1 478.65

Project Completed September 7, 1989

M-21 Wascana Creek below Kronau Marsh - 05JF012 - Federal-Provincial

Installed a screw-type and a rod-type bench mark both with standard markers. Installed an electric tape gauge.

Construction Cost:

Labour	194.26
Board & Accommodation	111.65
Travel	98.75
Material	145.00
Total	549.66

Instrumentation Cost:

Electric Tape Gauge	180.00
Total	180.00

Station Cost

Federal Share	364.83
Provincial Share	364.83
Total	729.66

Project Completed June 29, 1989

M-22 Wascana Creek near Sedley - 05JF004 - Federal-Provincial

Installed an electric tape gauge.

Instrumentation Costs

Electric Tape Gauge	180.00
Total	180.00

Station Cost

Federal Share	90.00
Provincial Share	90.00
Total	180.00

Project Completed July 10, 1989

M-23 White Fox River near Garrick - 05KE005 - Federal-Provincial

Dug in an insulated 3 NPS x 6.7 m lower pipe intake and a wooden box upper intake. Installed a new flushing unit on the lower intake.

Construction Cost:

Labour	1 021.40
Board & Accommodation	485.50
Travel	255.00
Material	443.39
Total	2 205.29

Station Cost

Federal Share	1 102.65
Provincial Share	1 102.64
Total	2 205.29

Project Completed June 8, 1989

M-24 Whitesand River near Canora - 05MB003 - Federal-Provincial

Removed unsafe cableway and cable car.

Construction Cost:

Labour	303.03
Board & Accommodation	186.00
Travel	196.25
Total	685.28

Station Cost

Federal Share	342.64
Provincial Share	342.64
Total	685.28

Project Completed June 21, 1989

M-25 Willow Brook at Willowbrook - 05MB005 - Federal-Provincial

Installed a screw-type and a rod-type bench mark both with standard markers.

Construction Cost:

Labour	269.12
Board & Accommodation	162.99
Travel	201.25
Material	125.53
Total	758.89

Station Cost

Federal Share	379.45
Provincial Share	379.44
Total	758.89

Project Completed July 6, 1989

M-26 Yorkton Creek near Ebenezer - 05MB001 - Federal-Provincial

Investigated complaint of control causing flooding.

Construction Cost:

Labour	170.00
Board & Accommodation	27.40
Total	197.40

Station Cost

Federal Share	98.70
Provincial Share	98.70
Total	197.40

Project Completed May 15, 1989

A.3 FEDERAL STATIONS

A.3.1 Federal Upgrading

U-2 Battle Creek near Consul - 11AB096 - Federal

Removed and reset the original 1.2 m x 3.0 m well crib. Installed a new 3 NPS x 6.4 m lower intake complete with a new flushing unit and a new pyrotenax heat tape. This intake was fixed with a metal slide to allow movement within the well crib. Built and installed a 3.6 m long wooden box intake. Built and installed a treated wooden well floor with 25 mm holes to relieve hydraulic pressure. Installed a screw-type bench mark with a standard marker. The initial instruments were reinstalled.

Construction Cost:

Labour	1 312.50
Board & Accommodation	824.93
Travel	699.75
Material	380.48
Contract Services	337.50
Total	3 555.16

Station Cost

Federal Share	3 555.16
Provincial Share	-
Total	3 555.16

Project Completed May 3, 1989

U-3 Beaver Creek at International Boundary - 11AF005 - Federal

Replaced the rock control and wading section with a Geoweb type. Mud was replaced with clay tamped to desired grade levels, placed geotextile and two 2.4 m x 6.0 m sections of Geoweb. The Geoweb was filled with crushed rocks and riprap was placed upstream and downstream of the control.

Construction Cost:

Labour	641.18
Board & Accommodation	239.69
Travel	397.50
Material	783.30
Contract Services	901.35
Total	2 963.02

Station Cost

Federal Share	2 963.02
Provincial Share	-
Total	2 963.02

Project Completed September 27, 1989

U-4 Huff Lake Gravity Canal - 11AC065 - Federal

Removed and reinstalled the original stilling well. Installed a new 3 NPS x 6.4 m lower intake complete with a flushing unit and installed a new upper 4.3 m wooden box intake. Replaced the shelter with a salvaged standard unwired one. Placed riprap around the intakes. Installed a rod-type bench mark with a standard marker. (The work was done to facilitate construction of new riparian outlet.)

Construction Cost:

Labour	2 355.19
Board & Accommodation	1 090.90
Travel	1 270.50
Material	1 670.21
Contract Services	550.00
Total	6 936.80

Instrumentation Costs

Electric Tape Gauge	180.00
Total	180.00

Station Cost

Federal Share	7 116.80
Provincial Share	-
Total	7 116.80

Project Completed September 20, 1989

U-5 Middle Creek below Middle Creek Reservoir - 11AB001 - Federal

Installed a gravel and rock wading section.

Construction Cost:

Labour	350.00
Board & Accommodation	155.78
Travel	413.25
Contract Services	332.50
Total	1 251.53

Station Cost

Federal Share	1 251.53
Provincial Share	-
Total	1 251.53

Project Completed May 11, 1989

U-6 North Saskatchewan River at Prince Albert - 05GG001 - Federal

Relocated the gauge installation to accommodate the city of Prince Albert with land fill.

Built a 3.0 m x 3.6 m wood structure building. Clad with vertical deformed colored metal siding and roof. Placed R20 insulation, vapor barrier and used standard interior paneling. Installed underground power service and a 1500W forced air electric heater. Trenched in a 2 NPS plastic pipe to protect the orifice line. Installed a rod-type bench mark and marker. Replaced the catamaran deck with an aluminum one. Repaired the hand railing, pontoons and rudder on the catamaran. Removed deteriorated shelter and cleaned up site. (no salvage).

Construction Cost:

Labour	4 777.18
Board & Accommodation	2 307.84
Travel	1 320.00
Material	2 762.38
Contract Services	3 561.53
Total	14 728.93

Station Cost

Federal Share	14 728.93
Provincial Share	-
Total	14 728.93

Project Completed September 8, 1989

U-7 Qu'Appelle River above Buffalo Pound Lake - 05JG004 - Federal

Removed the shelter, instrumentation, dug-out and extended the well one metre. Reinstalled the well with a wooden floor and two 3 NPS x 6.7 m pipe intakes complete with flushing units. The lowest intake is equipped with a pyrotenax type heat tape. Built and installed a wooden box upper intake. Lowered the control about one metre by excavating rocks, broken concrete slabs and placing the extra material into a scour hole on the right bank. Repaired the metering rail and cleaned up the site. Reinstalled the instrumentation.

Construction Cost:

Labour	1 713.90
Board & Accommodation	826.53
Travel	414.00
Material	1 370.33
Contract Services	1 060.00
Total	5 384.76

Station Cost

Federal Share	5 384.76
Provincial Share	-
Total	5 384.76

Project Completed December 7, 1989

U-8 Souris River near Glen Ewen - 05ND001 - Federal

Removed and salvaged Water Quality shelter. Removed Water Quality related pipes from the well. Extended power service directly to Water Resources shelter. Replaced the heat tape with a pyrotenax type and repaired the flushing unit.

Construction Cost:

Labour	1 039.54
Board & Accommodation	370.16
Travel	315.00
Material	-1 013.83
Contract Services	250.00
Total	960.87

Station Cost

Federal Share	960.87
Provincial Share	-
Total	960.87

Project Completed May 31, 1989

A.3.2. Federal Maintenance

M-27 Arcola Index Reservoir - 05NC006 - Federal

Extended upper 3 NPS pipe intake to the total length of 17.5 m. (3 NPS pipe was salvaged material).

Construction Cost:

Labour	217.76
Board & Accommodation	17.00
Travel	100.00
Material	7.67
Total	342.43

Station Cost

Federal Share	342.43
Provincial Share	-
Total	342.43

Project Completed August 22, 1989

M-28 Battle Creek at Alberta Boundary - 11AB117 - Federal

Replaced the cable car with a standard one and painted all other paintable components of the cableway. Installed a sag marker and repaired the cattle fence gate. (Salvaged material = $65.00)

Construction Cost:

Labour	594.09
Board & Accommodation	299.36
Travel	439.00
Material	390.10
Total	1 722.55

Station Cost

Federal Share	1 722.55
Provincial Share	-
Total	1 722.55

Project Completed May 9, 1989

M-29 Battle Creek below Nashlyn Project - 11AB101 - Federal

Replaced the heat tape with a pyrotenax type and replaced the heat tape switch. Repaired the intake flushing unit.

Construction Cost:

Labour	357.52
Board & Accommodation	172.24
Travel	189.75
Material	123.28
Total	842.79

Station Cost

Federal Share	842.79
Provincial Share	-
Total	842.79

Project Completed November 23, 1989

M-30 Cypress Lake - 11AC037 - Federal

Installed a rod-type bench mark with a standard maker.

Construction Cost:

Labour	161.78
Board & Accommodation	103.22
Travel	108.75
Material	51.65
Total	425.40

Station Cost

Federal Share	425.40
Provincial Share	-
Total	425.40

Project Completed May 11, 1989

M-31 Cypress Lake East Outflow Canal - 11AC060 - Federal

Installed a rod-type bench mark with a standard marker.

Construction Cost:

Labour	161.78
Board & Accommodation	103.22
Travel	108.75
Material	75.00
Total	448.75

Station Cost

Federal Share	448.75
Provincial Share	-
Total	448.75

Project Completed May 11, 1989

M-32 Denniel Creek near Val Marie - 11AC025 - Federal

Repaired the flushing unit and repaired the cattle fence around the shelter.

Construction Cost:

Labour	177.85
Board & Accommodation	87.36
Travel	121.25
Material	26.00
Total	412.46

Station Cost

Federal Share	412.46
Provincial Share	-
Total	412.46

Project Completed September 21, 1989

M-33 Dillon River below Dillon Lake - 06BA002 - Federal

Repaired vandalized shelter and installed heavier shop fabricated corners. The flying time was coordinated with a regular hydrometric trip as not to incur added costs.

Construction Cost:

Labour	1 124.04
Board & Accommodation	382.42
Travel	235.65
Material	281.04
Total	2 023.15

Station Cost

Federal Share	2 023.15
Provincial Share	-
Total	2 023.15

Project Completed January 24, 1990

M-34 East Poplar River at International Boundary - 11AE003 - Federal

Repaired the well ladders and installed a new heat tape switch.

Construction Cost:

Labour	303.03
Board & Accommodation	113.86
Travel	142.50
Material	9.00
Total	568.39

Station Cost

Federal Share	568.39
Provincial Share	-
Total	568.39

Project Completed July 26, 1989

M-35 Fahlman Creek near Davin - 05JF008 - Federal

Installed a rod-type bench mark with a standard marker.

Construction Cost:

Labour	151.52
Board & Accommodation	58.36
Travel	50.00
Material	66.75
Total	326.63

Station Cost

Federal Share	326.63
Provincial Share	-
Total	326.63

Project Completed June 15, 1989

M-36 Fond du Lac River at Outlet of Black Lake - 07LE002 - Federal

The cableway was vandalized. Restrung the aircraft warning marker cable and installed new turnbuckle. Tightened main cable and replaced the DCP board.

Construction Cost:

Labour	655.00
Board & Accommodation	205.24
Travel	120.00
Material	193.16
Contract Services	555.14
Total	1 728.54

Station Cost

Federal Share	1 728.54
Provincial Share	-
Total	1 728.54

Project Completed July 4, 1989

M-37 Last Mountain Lake at Rowan's Ravine - 05JH004 - Federal

Installed a rod-type bench mark with a standard marker.

Construction Cost:

Labour	241.52
Board & Accommodation	45.80
Travel	232.50
Material	78.20
Total	598.02

Station Cost

Federal Share	598.02
Provincial Share	-
Total	598.02

Project Completed August 29, 1989

M-38 Long Creek near Estevan - 05NB001 - Federal

Repaired the leaking metal control by cutting out rusted sections and welding in new sheet metal pieces.

Construction Cost:

Labour	657.71
Board & Accommodation	265.10
Travel	228.75
Material	16.50
Total	1 168.06

Station Cost

Federal Share	1 168.06
Provincial Share	-
Total	1 168.06

Project Completed May 30, 1989

M-39 Pipestone Creek above Moosomin Reservoir - 05NE003 - Federal

Installed a screw-type bench mark with a standard marker.

Construction Cost:

Labour	242.66
Board & Accommodation	138.08
Travel	121.00
Material	75.00
Total	576.74

Station Cost

Federal Share	576.74
Provincial Share	-
Total	576.74

Project Completed June 28, 1989

M-40 Pipestone Creek near the Saskatchewan Boundary - 05NG024 - Federal

Added rocks to the control.

Construction Cost:

Labour	420.52
Board & Accommodation	145.07
Travel	175.00
Contract Services	157.80
Total	898.39

Station Cost

Federal Share	898.39
Provincial Share	-
Total	898.39

Project Completed July 4, 1989

M-41 Qu'Appelle River below Loon Creek - 05JK007 - Federal

Installed a 3 NPS x 16.5 m pipe lower intake. The intake was pushed from inside the well consisting of 12 threaded sections joined with couplings. It was equipped with a flushing unit and a pyrotenax heat tape, both salvaged from an incapacitated intake. Added screened rocks to the control.

Construction Cost:

Labour	1 609.02
Board & Accommodation	110.50
Travel	200.00
Material	334.25
Contract Services	257.50
Total	2 511.27

Station Cost

Federal Share	2 511.27
Provincial Share	-
Total	2 511.27

Project Completed October 20, 1989

M-42 Stony Rapids Crew Cabin - 07LE000 - Federal

General yard clean-up. Installed a vent in the storage area.

Construction Cost:

Labour	140.00
Board & Accommodation	43.90
Travel	30.00
Contract Services	118.75
Total	332.65

Station Cost

Federal Share	332.65
Provincial Share	-
Total	332.65

Project Completed July 6, 1989

M-43 Swift Current Canal at Swift Current - 05HD034 - Federal

Desilted intakes and well.

Construction Cost:

Labour	188.16
Board & Accommodation	89.94
Travel	132.50
Total	410.60

Station Cost

Federal Share	410.60
Provincial Share	-
Total	410.60

Project Completed April 13, 1989

M-44 Swift Current Creek below Rock Creek - 05HD036 - Federal

Filled in void section of rock control to improve wading measurements.

Construction Cost:

Labour	473.03
Board & Accommodation	232.57
Travel	292.50
Contract Services	580.40
Total	1 578.50

Station Cost

Federal Share	1 578.50
Provincial Share	-
Total	1 578.50

Project Completed July 19, 1989

M-45 Tatagwa Lake Drain near Weyburn - 05NB018 - Federal

Recapped the wading section with crushed rocks and installed a screw-type bench mark with a standard marker.

Construction Cost:

Labour	454.55
Board & Accommodation	229.65
Travel	191.25
Material	75.00
Contract Services	92.61
Total	1 043.06

Station Cost

Federal Share	1 043.06
Provincial Share	-
Total	1 043.06

Project Completed July 24, 1989

A.4 PROVINCIAL STATIONS

A.4.1 Provincial Maintenance

M-46 Conjuring Creek near Preeceville - 05MC004 - Provincial

Installed a rod-type bench mark complete with a standard marker.

Construction Cost:

Labour	303.03
Board & Accommodation	183.36
Travel	125.00
Material	59.85
Total	671.24

Station Cost:

Federal Share	-
Provincial Share	671.24
Total	671.24

Project Completed July 5, 1989

M-47 Cutknife Creek near Cutknife - 05FF003 - Provincial

Inserted a 3 NPS plastic (ABS) pipe into the deteriorating wooden box intake.

Construction Cost:

Labour	149.89
Board & Accommodation	69.77
Travel	39.00
Material	49.70
Total	308.36

Station Cost:

Federal Share	-
Provincial Share	308.36
Total	308.36

Project Completed January 3, 1990

M-48 Hunter Creek near Richardson - 05JF014 - Provincial

Installed an electric tape gauge. (work done by hydrometric personnel).

Instrumentation Cost

Electric Tape Gauge	157.00
Total	157.00

Station Cost:

Federal Share	-
Provincial Share	157.00
Total	157.00

Project Completed July 4, 1989

M-49 Inverness Creek near Broderick - 05HG021 - Provincial

Replaced the heat tape with a pyrotenax type. Installed a rod-type bench mark with a standard marker.

Construction Cost

Labour	355.48
Board & Accommodation	193.15
Travel	112.50
Material	123.96
Total	785.09

Station Cost

Federal Share	-
Provincial Share	785.09
Total	785.09

Project Completed August 29, 1989

M-50 Ironspring Creek near Watson - 05MA012 - Provincial

Restored power to the heat tape.

Construction Cost

Labour	149.89
Board & Accommodation	69.77
Travel	39.00
Total	258.66

Station Cost

Federal Share	-
Provincial Share	258.66
Total	258.66

Project Completed January 4, 1990

M-51 Jackfish Lake near Cochin - 05EG003 - Provincial

Installed a rod-type and a screw-type bench mark, both with standard markers.

Construction Cost

Labour	387.80
Board & Accommodation	190.58
Travel	205.50
Material	124.00
Total	907.88

Station Cost:

Federal Share	-
Provincial Share	907.88
Total	907.88

Project Completed May 19, 1989

M-52 Jackfish River near Prince - 05EG007 - Provincial

Station discontinued; salvaged the unwired standard shelter and well staves. Back-filled and cleaned up site.

Construction Cost

Labour	569.86
Board & Accommodation	201.74
Travel	349.75
Material	-1 216.00
Contract Services	150.00
Total	55.35

Station Cost

Federal Share	-
Provincial Share	55.35
Total	55.35

Project Completed May 17, 1989

M-53 Little Bridge Creek near Armley - 05KB008 - Provincial

Built and installed a metal catwalk to the gauge.

Construction Cost

Labour	167.20
Board & Accommodation	63.24
Travel	30.00
Material	122.52
Total	382.96

Station Cost

Federal Share	-
Provincial Share	382.96
Total	382.96

Project Completed March 8, 1989

M-54 Morin Creek near Meadow Lake - 06AD008 - Provincial

Repaired rock control.

Construction Cost

Labour	90.00
Travel	45.00
Contract Services	60.00
Total	195.00

Station Cost

Federal Share	-
Provincial Share	195.00
Total	195.00

Project Completed July 13, 1989

M-55 Muddy Lake Inflow near Revenue - 05GB004 - Provincial

Repaired power service to the shelter.

Construction Cost

Labour	149.89
Board & Accommodation	69.77
Travel	39.00
Total	258.66

Station Cost

Federal Share	-
Provincial Share	258.66
Total	258.66

Project Completed January 2, 1990

M-56 Overflowing River near Hudson Bay - 05LD003 - Provincial

Removed corrogated metal pipe and california type shelter. (Salvaged pipe).

Construction Cost

Labour	222.11
Board & Accommodation	129.04
Travel	228.75
Material	-82.32
Total	497.58

Station Cost

Federal Share	-
Provincial Share	497.58
Total	497.58

Project Completed July 4, 1989

M-57 Page Creek near Iffley - 05EG008 - Provincial

Discontinued station; salvaged well and shelter. Backfilled well hole and cleaned up site.

Construction Cost:

Labour	569.86
Board & Accommodation	201.74
Travel	401.75
Material	-1 416.00
Contract Services	150.00
Total	-92.65

Station Cost:

Federal Share	-
Provincial Share	-92.65
Total	-92.65

Project Completed May 17, 1989

M-58 Van Pattens Creek near Kuroki - 05MB011 - Provincial

Removed and salvaged shelter, well and A-frames. Buried intake, left bank deadman and pedestals.

Construction Cost:

Labour	584.34
Board & Accommodation	323.86
Travel	301.00
Material	-2 190.60
Contract Services	247.50
Total	-733.90

Station Cost

Federal Share	-
Provincial Share	-733.90
Total	-733.90

Project Completed June 20, 1989

APPENDIX B

Description of Construction

Practices, Materials and Equipment

B.0 DESCRIPTION OF CONSTRUCTION PRACTICES, MATERIALS AND EQUIPMENT

B.1 SAFETY

Safety of structures is of the utmost importance and has the highest priority. However, there is no substitute for common sense. Numerous things are done to make the gauging sites a safer work place. Access aluminum ladders in stilling wells are mounted in such a manner as to allow 180 mm toe room. Instrument shelters are equipped with door holders, extended inside gauges and trap door holders. The electrical installation meets all provincial safety regulations. Safety inspection of cableways is completed each year and those found in poor or unsafe condition have been rebuilt in the continuing program of replacing the wood structures with steel. Heat tape switches are replaced with pilot light switches, and electric tape gauges are used in most stilling wells. The construction crew is supplied with the necessary safety equipment during construction and are trained in safe construction practices.

B.2 INSTRUMENT SHELTERS

The standard instrument shelter is a 1600 mm x 1600 mm x 2500 mm walk-in galvanized pre-fabricated 24 gauge steel building. It is insulated and lined with 3 mm plywood panelling over a polyethylene vapour barrier and fitted with an appropriate instrument shelf. Shelters are shop assembled in Regina and wired for 115 V, 30 A electrical entrance service. In remote areas, some shelters are assembled on site, however, most are shop assembled and flown into site by helicopter.

For servo-manometer installations a standard instrument shelter is erected on a steel reinforced light aggregate concrete slab. In some remote northern installations where suitable granular material is not available, 100 mm x 100 mm lumber is used with a 20 mm plywood floor.

For installations over wood stave wells, the standard shelter is erected on a 76 mm x 76 mm x 5 mm angle-iron frame. The instrument shelter has a 19 mm plywood floor with an access trap door to the well that is held in the open position by a screen door holder.

Gauging stations in northern Saskatchewan are constructed with an interior instrument cabinet 1700 mm high and 800 mm wide (outside dimensions) and insulated with 75 mm stryolite. The inner cabinet is equipped with a Catadyne heater with a 300 kJ/hr output which keeps it approximately 20°C above ambient temperature. The above installation is referred to as a northern heat package.

Since 1988 the standard northern shelter is constructed in the Regina warehouse without the northern heat package. Instead the wall insulation was increased to R24 value, the roof to R36 value and the floor is insulated R24 value. The above heating system is still used. This shelter has a lifting harness incorporated in it.

B.3 STILLING WELLS

B.3.1 General

All inbank installations of stilling wells are made with wood staves radially milled to internal and external circumference of the well diameter. Most well installations are 1500 mm inside diameter. Staves are interlocked by tongue and groove and the edges of the staves are in full bearing with each other. Commonly used softwood species are pine, western and eastern hemlock and Douglas fir. Any softwood which meets grading specifications and is suitable for pressure treatment may be used. All staves are pressure treated in accordance with C.S.A. 080 Specification Group, Pentachlorophenol. Standard staves for 1500 mm inside diameter wells are 70 mm thick with the most common length being 2400 mm. Access to the bottom of the well is by aluminum ladder, extending the full depth of the well, and installed in such a manner as to leave 180 mm toe clearance. A short, 1.8 m, aluminum safety ladder is similarly installed directly opposite from the access ladder. This is an aid to reading the inside gauge.

B.3.2 Upper Intake System

The upper intake normally consists of a box culvert made of treated 50 mm x 152 mm wooden plank built in rotation and placed approximately 300 mm above the normal winter ice level. A galvanized, 12 mm square, 16 gauge wire mesh screen is stapled to the stream end of the box culvert to prevent trash and small

animals from entering the well. For deeper wells and where in-bank distances are long, a 3 NPS steel pipe is normally substituted for the box culvert.

B.3.3 Lower Intake System

The lower intake consists of a 3 NPS black steel pipe placed near the stream bed. In streams where the velocity past the pipe may cause significant drawdown, the intake pipe is provided with a static tube. The lower intake is reduced to take a 2 NPS cross fitting immediately inside the well. On the right angle side of the cross fitting a 2 NPS standard shut-off valve is placed with the opposite side accommodating a standard flushing system. Where power is available, the in-line opening of the cross fitting may be used for installation of a heat tape, which is placed the full length of the pipe. The bottom of the intake is usually installed 300 mm to 600 mm above the bottom of the well cribbing to allow for silt deposition.

B.3.4 Inside Gauge

Inside gauges are made by mounting 80 mm x 1000 mm gauge plates on 38 mm x 184 mm treated timber installed in the well. Inside gauges are extended through the instrument shelf to facilitate direct level reading essential during high water. Electric tape gauges complement are the standard inside gauges and have eliminated the need to install inside gauges in new stations. They are accurate and do not require entering the well.

B.3.5 Well Floor

The standard well floor is a 150 mm slab of steel-reinforced concrete placed 600 mm below the lower intake pipe. If the bottom of the well excavation is wet and the material semi-fluid because of a high local water table, a treated plank floor is placed in the bottom, held together by an angle iron on the periphery having uprights welded to it. The uprights are lagged to the staves with 10 mm x 64 mm lag bolts. Spacing between planks relieves hydraulic pressure.

B.4 CABLEWAYS

B.4.1 A-Frames

All cableway A-frames are built to standard plans, and fabricated from 4 NPS black iron pipe. A-frames with a height of 2400 mm or more, have a cable car loading platform with access steps. The standard steel loading platform consists of a 1 370 mm x 1800 mm angle iron frame filled with an open non-skid surface steel planking. This unit is fastened and braced to the standard A-frame in an offset position to facilitate loading of the cable car. The angle iron is 51 mm x 51 mm x 5 mm. The steel planking is ARMCO type III having a width of 229 mm, depth 51 mm, interlocking legs, and made from 16 gauge galvanized steel. Access steps are fabricated from the same material. All units including the cable car are painted international orange and white to Transport Canada specifications. A-frame pedestals are normally constructed using concrete made from sulphate resistant cement with a maximum aggregate size of 25 mm. Sono

tube of 610 mm diameter is normally used for forms extending 600 mm to 900 mm into the ground. Transit mix is used where available; if not, the concrete is mixed on site.

B.4.2 Anchorage

The standard size of the deadman used in most soil types and for cable spans less than 100 m is 1200 mm x 1200 mm x 900 mm deep or larger as required and made from sulphate resistant cement and reinforced with steel bars. Cable anchorage for the main cable consists of one 25 mm diameter bar 3500 mm long bent into a triangular shape and embedded in the deadman. A 20 mm diameter, 1800 mm long bar bent into a triangular shape is used for anchorage of the A-frame tieback cable.

Rock anchors are used at locations where bedrock is exposed at the surface. Normally two rock anchors are installed with one acting as the cable anchorage and the second cabled to the first as a safety backup. The rock anchor normally used is CLM Industries Catalogue Number 9026TE rock guy bolt anchor with wedge. A 25 mm diameter hole is drilled in the bedrock at an angle of approximately 90° to the slope of the main cable and drilled to a depth of approximately 380 mm. The anchor is pounded into the hole which expands the bottom of the anchor and centres it in the hole. The remaining void is then filled with a polymeric M-bed superflow grout unless the temperature is below freezing then an epoxy U-grout is used.

B.4.3 Cable (Wire Rope)

For most main cables a 19 mm diameter cable is standard. A safety factor of 6:1 is used in design of cable size, sag and attachment. Table 4 denotes the use and specifications of cable used.

TABLE 4

STANDARD CABLES

USE	Cableway-main Cable	Tie Backs & Aircraft Warning Markers	Arctic Permanent Tagline	Tagline
DIAMETER	19.05 mm	9.525 mm	4.762 mm	3.175 mm
CONSTRUCTION	6 x 19 right lang lay improved plow steel	6 x 19 right lang lay mild plow steel	Aircraft control cable 7x19	Aircraft control cable 7x19
CORE	Fibre	Fibre	Steel	Steel
BREAKING STRENGTH	191 kN	53 kN	18.7 kN	8.9 kN
MASS	1.34 kg/m	0.34 kg/m		
REMARKS	Galvanized	Galvanized	Galvanized	Galvanized

B.4.4 Turnbuckles

All turnbuckles are drop forged and galvanized. On long cableways (60 m or more) turnbuckles are placed on both ends of the cable to allow for more adjustment of sag tension.

(1) 32 mm x 610 mm jaw and eye with 610 mm takeup. 1064 mm overall length in closed position. Strength 235 kN.

(2) 19 mm x 457 mm jaw and eye with 457 mm takeup. 737 mm overall length in closed position. Strength 80 kN.

(3) 13 mm x 305 mm jaw and eye with 300 mm takeup. 500 mm overall length in closed position.

B.4.5 Crosby Clips

For 19 mm diameter cable four 19 mm clips are used with 460 mm minimum turnback from heavy duty thimble on the end of the cable to give maximum strength.

For 10 mm diameter cable, three U-type 10 mm clips are used with 180 mm minimum turnback from thimble on the cable to give maximum strength.

B.4.6 Thimbles

Thimbles used are regular pattern, extra heavy duty and galvanized. They are used for sharp cable bends and points of wear.

B.4.7 Aircraft Warning Markers

Standard extensions are designed for attachment to 4 NPS pipe A-frames. Angle iron supports are two 76 mm x 76 mm x 6 mm x 3000 mm angle iron. 2 NPS x 300 mm pipe are welded between the two angle irons for spacers and to support aircraft warning marker cable.

The support is then bolted or welded to the back of the A-frame to give the desired height above the main cable depending on the span, 10 mm or 6 mm cable is used to carry the marker cones. The cable is anchored to the deadmen and is provided with a turnbuckle for adjustment.

The marker cones for a cableway are 460 mm high with a base diameter of 460 mm and the cones for a tagline are 300 mm high and have a base diameter of 395 mm. Both cones are made of fibreglass and are international orange or white in color. The cones are purchased from various suppliers.

B.4.8 Cable Cars

The standard sit-down car with two seats and foot rest is 1800 mm x 600 mm constructed with treated 50 mm x 100 mm wood frame covered with treated 16 mm plywood. The top edge of the plywood is covered with a galvanized 24 gauge metal strip 20 mm wide and 13 mm sides to protect and keep moisture out. Two drain holes are drilled immediately above each seat to

prevent moisture build-up and deterioration. Standard cable car hangers and footrest irons are made of 5 mm x 50 mm mild steel flat iron and are fastened to the cable car in such a manner that the sides of the seat are clear of obstructions. Sheaves are 200 mm diameter cast iron grooved for 19 mm cable and supplied with two SKF 1716204-012 sealed bearings. Movement is by hand cable puller. The unit is painted international orange and white to Transport Canada specifications.

The lightweight sit-down car with two seats is approximately 25 kg. The main structure is made of 25 mm square aluminum tubing; hangers and foot rest consists of 50 mm x 6 mm aluminum strap, hinged so as to fold into the car for transport or storage. The sheaves are 152 mm diameter aluminum alloy supplied with SKF 1716204-012 sealed bearing. Movement is by hand cable puller.

B.4.9 Cable Car Puller

The cable car puller normally used is adjustable to cable size, and is available in long and short handle sizes and is constructed from aluminum alloy according to standard Water Resources Branch plans.

B.4.10 Cable Car Lock and Holder

The cable car holder is constructed from 50 mm x 6 mm strap iron which is bolted or welded to the A-frame. The holder is positioned so that a "U" shaped hook at the end of the holder will engage the cable car support arm. Car is secured when not in use by a 900 mm x 10 mm chain fastened to the A-frame and attached to cable car support arm and padlocked.

B.5 METERING BRIDGE

A small lightweight metering bridge has been developed to replace very short span cableways of not more than 25 m in length. The cost is comparable to the construction of a cableway at the same site. The bridge is built of 25 mm x 25 mm tubing and is similar to a simple truss bridge of the Pratt design. The deck is composed of 4 or 5 widths of interlocking non-slip steel planking (Armco Inter-locking Grating). A pipe railing on both sides is for safety and measuring.

B.6 ARTIFICIAL CONTROLS

Most artificial controls are designed on a "one of a kind" basis giving consideration to flow range, stream bed material and banks, accuracy required and availability of construction materials. A number of types as described below have been utilized dependent on conditions.

B.6.1 Steel Sheet Piling

There are a number of different weights (gauges) of steel sheet piling which may be utilized with the most common having a horizontal covering width of 500 mm. All are deformed and have interlocking edges. They are obtainable in such common lengths as 2400 mm, 3000 mm, 3600 mm etc. Armco M581 or equivalent is used in the Saskatchewan district. The channel shape determines piling requirements. Piling may be driven below the frost line in suitable stone-free soil, otherwise it is dug in. The

portion above the stream bed is trimmed to any desired profile and is protected on the downstream side by rock rip-rap and the upstream side with crushed rock or screened rock formed into a wading apron. Steel sheet piling is also used with steel reinforced concrete heads having various shapes for different types of controls and wading sections. The piling forms a cut-off wall that is driven below the frost line for stability, and gives support to the concrete head.

B.6.2 Concrete

Various designs and sizes of concrete controls have been constructed, examples being broad-crested weirs, Trenton type, Parshall flumes and small wading sections with cut-off walls. These structures are usually constructed of steel reinforced concrete. The steel reinforcing is commonly 10 mm or 13 mm deformed mild steel bar. The concrete normally specified is 27.6 MPa with a maximum 20 mm aggregate.

B.6.3 Rock and Gravel

Extensive use has been made of crushed rock, screened rock and gravel to improve natural stream bed control characteristics and to provide a uniform section for wading measurements. The cost is significantly less than a rigid type of artificial control, and provided the upstream and downstream slopes to the crest are kept to less than 10 to 1, the stability is relatively good.

B.7 BENCH MARKS

There are three types of bench marks (BM) used in the Saskatchewan network. Two BMs are normally placed at each hydrometric station.

At some stations where there is appropriate stability such as bedrock or concrete bridge abutment etc., a plug BM with standard WSC head is drilled and grouted in.

The rod BM consists of a number of sections of 19 mm diameter rods approximately 1.200 mm long. The first length, or starter rod, to be driven is a deformed re-bar having at one end a 50 mm taper and a blunt end of 6 mm. The following rods are smooth mild steel cold roll. All rods are joined by using the standard friction fit electrical ground rod coupler which tightens as the rods are driven. An electric hammer (Bosch 11304 Magnum) with 1450 blows per minute is used to drive the rod type BM to the point of refusal. The excess rod is cut off nearly flush with the ground and the standard bronze WSC cap is put on and fastened by a 6 mm cross pin. This BM type is primarily used where the site is inaccessible by truck or where rocks are more dominant.

The screw BM consists of 19 mm x 3000 mm rod welded to the end of a 38 mm square shaft 300 mm long with a single 150 mm diameter helical plate 10 mm thick welded to it. A 3500 mm long adaptor fits on the square shaft and is driven with the hydraulic crane. The BM is augered into the ground its full length and a standard bronze WSC cap is installed. This BM type is only used in boulder free locations which are accessible by vehicle.

Limited vehicle access to some of the gauging stations has prompted the purchase of a portable two-man power auger to drive modified screw bench marks. The modified 2200 mm long bench marks are comprised of a 19 mm diameter steel rod with a single 150 mm diameter helical plate, 6 mm thick, welded to it.

B.8 FENCES

Some cattle guard fences are constructed of pressure treated 50 mm x 150 mm x 3700 mm rough planks and 130 mm to 180 mm x 2100 mm treated fence posts. The planks are bolted to the posts with 10 mm x 200 mm U.S.S. cadmium plated bolts. A galvanized metal access gate with swing latch is incorporated into the three plank fence system. Other cattle guard fences consist of 2 NPS metal pipe covered with 3 NPS ABS plastic pipe. A single row of pipe surrounds the shelter except for a small opening in front of the door. The rolling action of the plastic pipe appears to discourage the cattle from rubbing.

B.9 CONSTRUCTION PERSONNEL

Crew supervision is carried out by a full-time construction supervisor. Only direct on-the-job input from the supervisor is included as a cost item. Indirect cost such as planning, scheduling, logistics, control and administration are not included in the costs contained in this report.

Reconnaissance and pre-construction surveys are carried out by both hydrometric and construction supervisory staff.

B.10 EQUIPMENT

The construction program is carried out using a combination of in-house resources and equipment and contracts. The crews are self-sufficient in terms of hand tools and common power tools such as generators, cement mixers, drills, saws and pumps. Two vehicles are assigned to the construction section, a 20 000 GVW rated truck complete with gravel box, hoist, front end winch and a hydraulic crane mounted behind the cab. This unit is used for placement of prefabricated shelters, driving steel sheet piling, and hauling riprap and construction materials. A three ton van is used for small storage of materials, tools and as a mobile workshop. Trailers are also used to transport shelters and construction materials. This equipment is assigned to the program to make crews as self-sufficient as possible.

Service contracts or standing offers are utilized to hire local contractors for such work as wiring of shelters, transit-mix concrete, excavation and backfill, hauling construction materials, placement of riprap and aggregate and special services such as construction of access roads.

APPENDIX C

PHOTOGRAPHS

DILLON RIVER AT OUTLET
OF DILLON LAKE - 06BA002

Vandalized Manometer Shelter

DILLON RIVER AT OUTLET OF DILLON LAKE - 06BA002

Shelters after Repairs

SOUTH SASKATCHEWAN RIVER
AT SASKATOON - 05HG001

Excavating for New Well
Crib Installation

SOUTH SASKATCHEWAN RIVER
AT SASKATOON - 05HG001

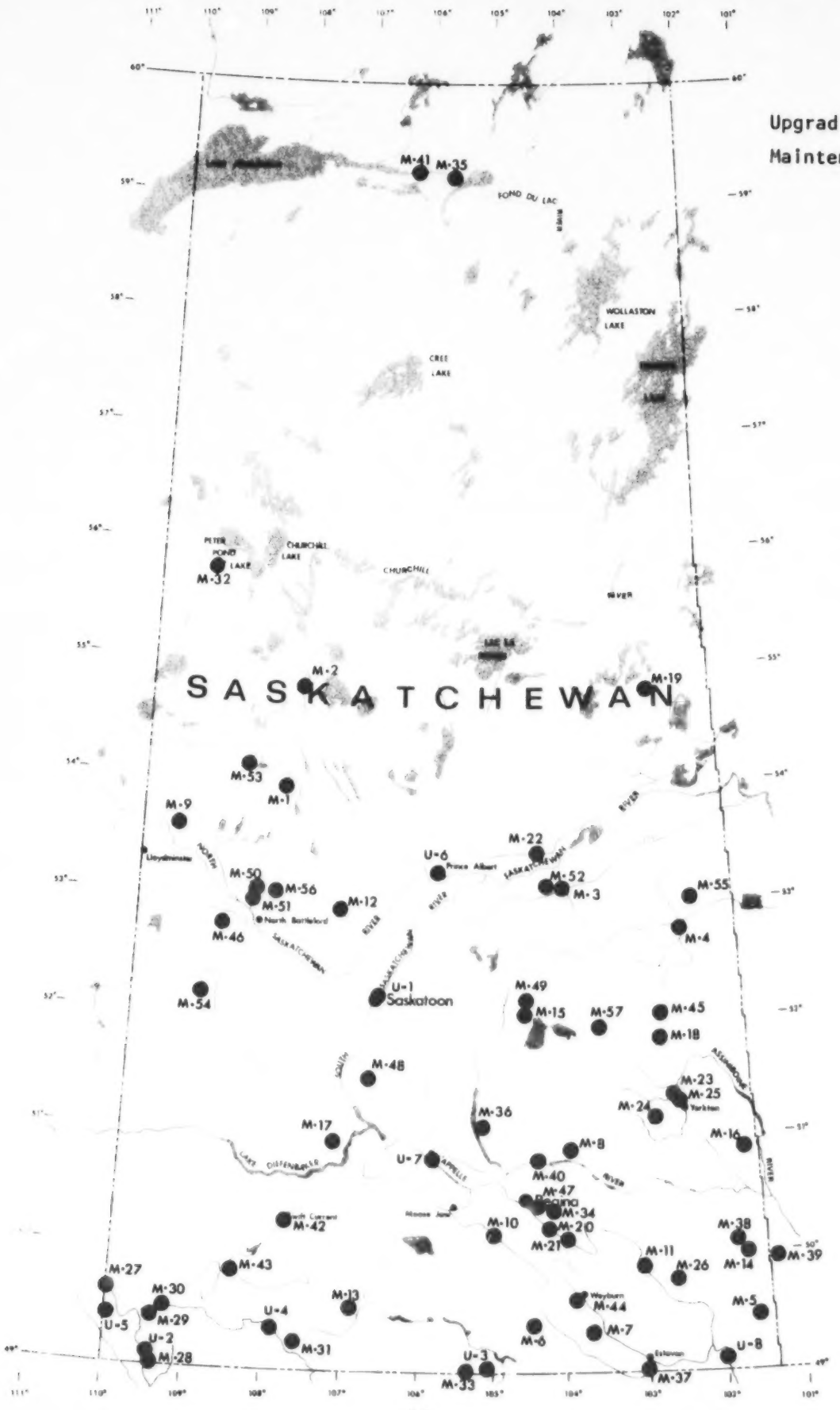
Finished shelter
Completed to Meewasin Valley
Authority Specifications.

NORTH SASKATCHEWAN RIVER
AT PRINCE ALBERT - 05GG001

Finished Manometer Shelter.
Completed to City of Prince
Albert specifications.

APPENDIX D

MAP


LEGEND
Upgrading U - ●
Maintenance M - ●
SASKATCHEWAN
M-41
M-35
POND DU LAC
RIVER
WOLLASTON LAKE
CREE LAKE
PETER POND LAKE
M-32
CHURCHILL LAKE
CHURCHILL
RIVER
M-2
M-19
M-53
M-1
M-9
U-6
Prince Albert
M-22
SASKATCHEWAN
RIVER
M-50
M-56
M-51
North Battleford
M-12
M-46
M-52
M-3
M-55
M-4
M-54
U-1
Saskatoon
M-49
M-15
M-57
M-45
M-18
M-48
M-23
M-25
Yorkton
M-24
M-36
M-17
LAKE DIEFENBAKER
U-7
M-8
M-40
M-47
M-34
M-16
M-42
M-10
M-20
M-21
M-38
M-39
M-11
M-26
M-14
M-43
M-27
M-30
M-29
U-5
U-2
M-28
M-13
U-4
M-31
Weyburn
M-44
M-5
M-7
M-6
U-8
U-3
M-33
M-37